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The work consists of two parts, of which the first treats of the teleological laws of nature, and the second of the methods for the investigation of these laws.

Necessary connections or natural laws the author finds to be the objects of science. Empirical science, and especially the scientific concept of cause, is discussed to some extent, but by far the greater part of the book is devoted to what might be termed the philosophy of biology.

Causality, having been defined in terms of general empirical science, and also of special biological science, the biological concepts of living, organic, etc., are analyzed in an interesting fashion.

Under methods of investigation the possibility of methodical work in the teleological sphere is discussed in connection with the standard methods: induction and deduction.

R. M. Y.

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## ZOOLOGY.

**The Effect of the Staleness of the Sex-Cells upon Development** and upon the formation of hybrids has been reinvestigated by Dr. H. M. Vernon.<sup>1</sup> He finds in the case of the echinoderms that the number of normal blastulæ formed from sex-cells kept for some time in sea water diminishes about one per cent per hour up to the twenty-seventh hour, after which time abnormalities rapidly increase in number. Within this period the same decrease was noted whether either or both of the sexual products were stale, but after the twenty-seventh hour the decrease in normal embryos was most rapid when both of the sex-cells were in this condition. The larvæ obtained from stale sex-cells were of the normal size, though when the sperm alone was stale they were often larger, and when the ovum was stale they were smaller, than those derived from fresh products. Contrary to the conclusion of the Hertwigs, staleness of the ova in hybrids of *Sphærechinus* ♀ × *Strongylocentrotus* ♂ did not increase the number of hybrid plutei, though in the reciprocal cross a larger percentage of blastulæ was produced. The hybrid larvæ obtained on crossing *Sphærechinus* ova with *Strongylocentrotus* spermatozoa vary

<sup>1</sup> Vernon, H. M. The Effect of Staleness of the Sexual Cells on the Development of Echinoids, *Proc. Roy. Soc.*, vol. lxxv (1899), pp. 350-360.

Vernon, H. M. Cross Fertilization among Echinoids, *Arch. f. Entwicklungsmechanik der Organismen*, Bd. ix (1900), pp. 464-478.

in type at different seasons of the year. In the summer, when the sexual products of the latter are at a minimum of maturity, the hybrids show a greater resemblance to pure *Sphærechinus plutei* than do those obtained in the spring. C. A. K.

**Protozoan Studies.** — The continuation of Dr. Prowazek's<sup>1</sup> work upon the Protozoa contains his observations on many species and discussions of many protozoan problems for whose solution the fragmentary evidence offered, though important in its bearings, is often insufficient. The reproduction of the Rhizopoda is illustrated by stages in the copulation of *Euglypha* and *Trinema*, and by sporulation in the autumn months in the same genera and also in *Nebela*, though no relation between the two processes was detected. These genera are frequently parasitized by *Achromatium oxaliferum*, and in this condition superficially resemble stages in sporulation. Autotomy was observed in *Amœba* and in *Nebela*, the rejected portion of the body usually containing the detritus from food vacuoles. From many observations on different species the author concludes that the formation of pseudopodia is always initiated by the ectoplasm. The structure and movements of flagella and of cilia are discussed and the inclusions in protoplasm are described and classified. Six types of non-living inclusions are recognized: (*a*) the Microgranula, composed of minute particles, the products of metabolism, found principally near the vacuoles and the ectoplasm; (*b*) the Hyalogramula, derived from the first and composed of transparent, bluish-green, somewhat refractive, elongate or flattened granules which are abundant near the vacuoles in the endoplasm and are also frequently found on cysts and in gametes; (*c*) the Lamprogranula, consisting of yellowish or greenish, spherical or oval, highly refractive bodies apparently enclosed in vacuoles and usually exhibiting Brownian movements; (*d*) excretory inclusions of spherical form, often with concentric structure and central cavity; (*e*) excretory crystals of various types; (*f*) the Leucogramula, composed of colorless, slightly refractive granules in the ectoplasm of *Stentor* and some other ciliates.

A sessile heliozoan of unique form and habitus, *Myxodiscus crystalligera*, is described from a marine aquarium. Sessile life has induced a polar differentiation, the pseudopodia being confined to the free surface. Its food consists of ciliates. *Phacodinium muscorum*, a new ciliate, is described from damp woodland moss. C. A. K.

<sup>1</sup> Prowazek, S. Protozoenstudien, II, *Arb. zool. Inst. Wien*, Bd. xii (1900), 58 pp., 2 pls.